Lewis and Clark State Office Building
Renewable Energy Resources

We all want to find solutions to the issues of the growing energy demand and global climate change, along with their impact on our economy. Considering that almost 50 percent of the energy use and carbon emissions come from building energy consumption, anything that is done to reduce energy use or substitute it with renewable resources plays a part in the solution. Although there is no one solution to cure all energy-related ills, the use of on-site renewable energy technologies such as solar water heating, photovoltaics and wind are key components of the solution.

During the design phase of the Lewis and Clark State Office Building (LCSOB) the use of wind energy, photovoltaics and solar water heating were considered. The selection of systems depended upon several key criteria, including: geographic location, cost of the system, utility cost and available technology. Both photovoltaics and solar water heating systems were included in the final design of the building.

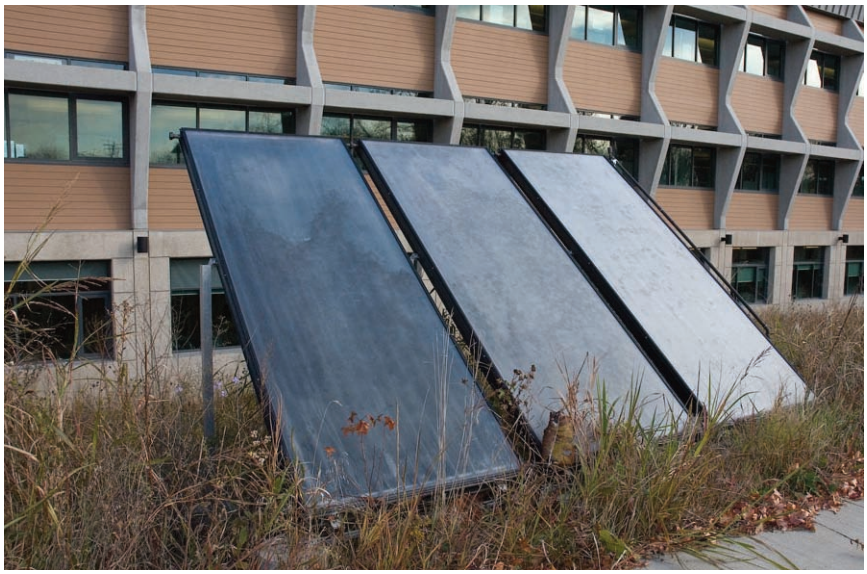
Analysis of wind resources were conducted as the building was being designed and after post-occupancy. These analyses confirmed that the site was not a good location for the currently available wind technology.Data collected from a 20 meter (65.5 ft) anemometer tower indicated the average annual wind speed on-site was 6.32 mph which is significantly below the recommended 12 to 14 mph required to make wind generation economical. Topography and obstructions, more specifically trees and to some degree the building, played a role in the low wind speed at this site. However, wind speeds at the Jefferson City, Missouri airport, just north and below the building site, was not a great deal more than the wind speeds calculated on-site.

Solar and Domestic Hot Water System

Office buildings with primarily daytime operations offer an excellent opportunity for the use of solar thermal water heating. Solar thermal water heating has a prime, high-profile location at the LCSOB and is easily the most economical of the current renewable systems that can be installed on a building. The ground-mounted, three-collector system sits in front of the building, facing the main parking lot. The system is designed to supplement the domestic water heating needs of the building. Ideally, these systems are designed to provide 50 to 90 percent of a building's water heating needs.

Specific hot water uses include restroom and kitchenette sinks, mop sinks and the showers in the first floor rest rooms. The system preheats domestic cold water prior to entering the high-efficiency natural gas water heater, reducing the energy needed to bring the water up to the required operating temperature.

System components include the three solar collectors, a heat exchanger, a preheat tank and the circulation pump and piping. The energy captured by the solar collectors is transferred through a water and glycol cir-



A ground-mounted, three-panel, solar thermal system sits in front of the Lewis and Clark State Office Building. The unit supplements the water heating needs of the facility.

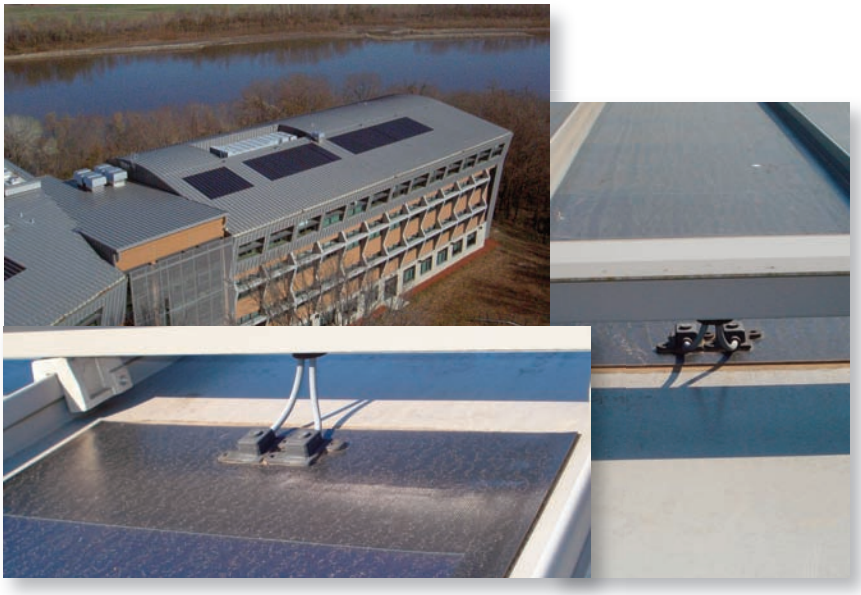
culation loop to the heat exchanger. The glycol provides system freeze protection through the winter months. From the heat exchanger, water from the preheat tank is circulated to provide hot water for the building. From the preheat tank, the water enters the water heater that brings the water up to operating temperature and provides the heating needs during cloudy and cold weather. The circulation pumps are switched on by a controller that operates based on the temperature differential between the temperature sensors located at the collectors and at the preheat tank.

Controller and circulation pump (left) and preheat tank and heat exchanger (above).

Solar and Domestic Hot Water Systems components:
Collectors -- 3 Heliodyne Gobi 410 Collectors
Controller -- Heliotrope Thermal, Delta-T
Heat exchanger --
Preheat tank – A.O. Smith 200-gallon

Photovoltaic System

When someone mentions renewable energy, one of the first things that comes to mind is solar electric systems, or photovoltaics (PV). However, for the average visitor of the LCSOB they might not realize that this green building has a 22 kW PV system on the roof. When traveling north on Riverside Drive toward the facility, you can see the 168 dark-colored 128-watt Uni-Solar photovoltaic modules laminated to the gray, standing-seam metal roof. These modules



Lewis and Clark State Office Building's rooftop PV array and detail shots of PV component grid connections.

Subarrays are wired in parallel in the DC combiner box (above). The Xantrex inverters (above right) convert the DC power from the solar panels to the AC utility power of the building. Fused disconnect switches protect the PV system and the utility grid from power surges (right).

comprise the grid-tied PV system, which supplies a small portion of the building's electrical energy needs.

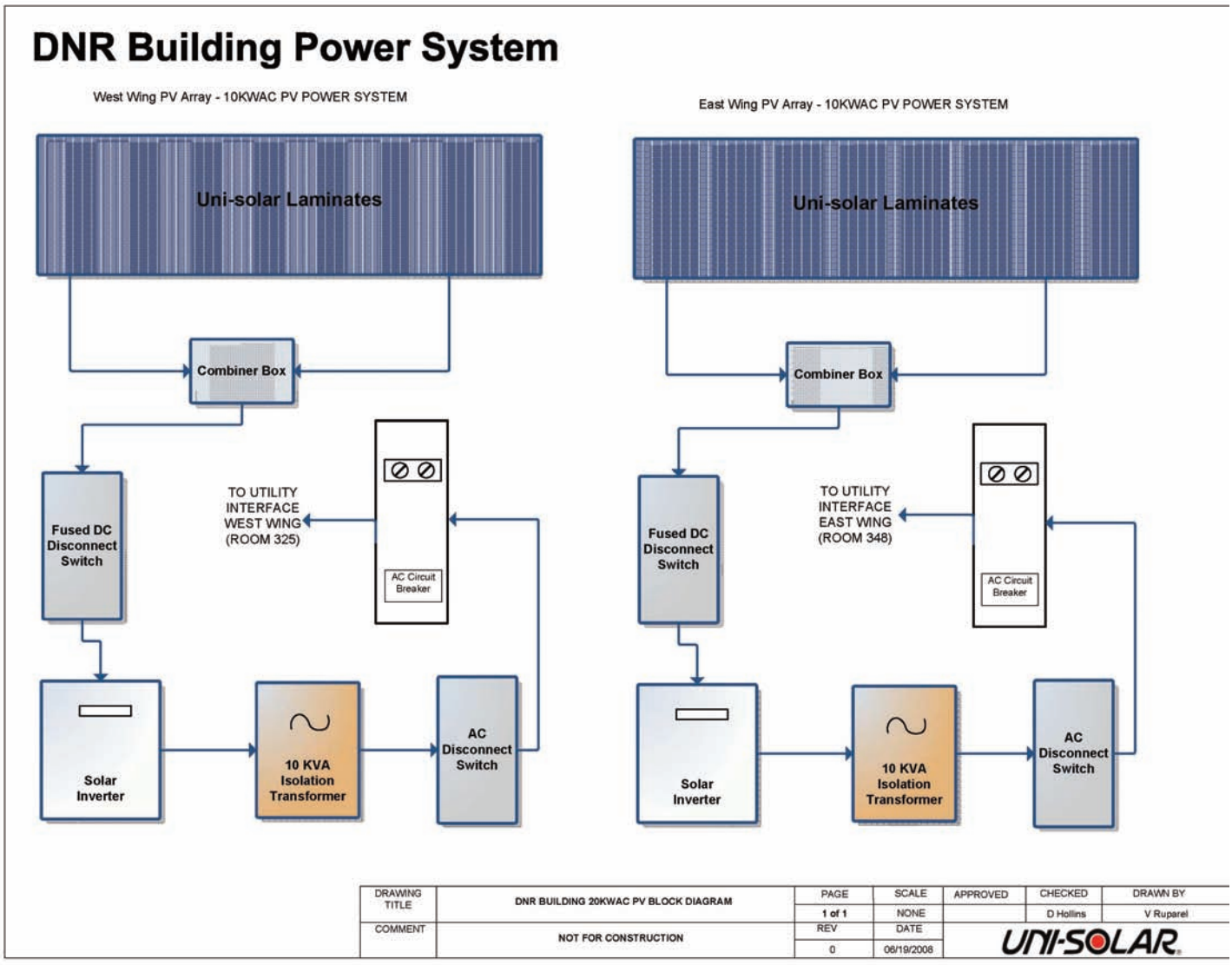
The original design intent was to produce 2.51 percent of the building's energy needs. Having this system on the structure also provided one LEED® credit, which helped in earning a LEED Platinum rating for the LCSOB.

The PV system is actually split into a 72-module array on the east side of the building and a 96-module array on the west side of the building for a total peak power of 21.504 kW. Each array is made up of sub-arrays of 12 modules, each wired in series to provide the operating voltage required by the two Xantrex inverters. The sub-arrays are then connected in parallel in the DC combiner box. The positive and negative conductors are then connected to the inverter after being fed through a fused DC disconnect switch.

The inverter is the critical component of the system that converts the DC voltage of the PV Array to the AC voltage of the buildings electrical system and the overall utility grid.

Two aerial views of the Lewis and Clark State Office Building that show the solar arrays on the roof. These shots were taken before the LCSOB's water tower was dismantled and re-constructed in Branson West, Mo.

(All inverters have to meet the standards set by the IEEE 929 standard regarding equipment and functions necessary to ensure compatible operation of PV systems which are connected in parallel with the electric utility. UL 1741 is the test procedure performed by Underwriters Laboratory to verify that the inverter meets the requirements of IEEE-929.)



Decisions to place renewable energy sources in the building were based upon efficiency of systems, according to the life cycle costs, and the value placed upon the demonstration capabilities of the technology as a resource to the department and its mission. However, cost was a primary factor in the decision making process. While some technologies like wind were of value to the department as a demonstration of existing technology, functionality and payback were paramount to being able to construct the most energy-efficient building possible.

MISSOURI DEPARTMENT OF NATURAL RESOURCES

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